

## DIVISION 500 RIGID PAVEMENT

### SECTION 501 PORTLAND CEMENT CONCRETE PAVEMENT

#### 501.1-DESCRIPTION:

This work shall consist of a pavement composed of portland cement concrete, with or without reinforcement as shown on the Plans, constructed on a prepared subgrade or base course in accordance with these Specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the Plans or established by the Engineer.

At the option of the Contractor, pavement shall be constructed with equipment utilizing fixed-forms or by the use of slip-form paving equipment.

Pozzolan materials (fly ash, ground granulated blast furnace slag and microsilica) conforming to the provisions of these specifications may be used as an additive to Portland Cement Concrete Pavement at the Contractor's option. These additives are not permitted when a blended hydraulic cement is used.

A water reducing admixture may be used at the Contractor's option. A water reducing admixture shall not be used in conjunction with a water reducing retarder.

#### 501.2-MATERIALS:

Materials shall meet the requirements of Division 700, as follows:

MATERIAL	SUBSECTION
Portland Cement	701.1, 701.3
Air Entraining Admixture	707.1
*Fine Aggregate	702.1
Coarse Aggregate	703.1-4
Performed Elastomeric Joint Seals; Lubricant-Adhesive	708.2
Preformed Expansion Joint Filler	708.1.1 (Type 1), 708.1.2
Low Modulus Silicone Joint Sealant; Back-Up Material	708.4

### 501.2.1

MATERIAL	SUBSECTION
Pavement Reinforcement	709.4, 709.6
Coated Dowel Bars	709.15
Tie Bars	709.1
Joint Tie Bolt Assembly	709.7
Water	715.7
Water Reducer	707.3
Pozzolan Additives	707.4
Curing Materials	707.6-707.10

\* NOTE: The use of limestone will not be permitted.

**Shipping and Storage of Cement:** Cement shall be shipped from pretested and approved bins at the mill or other terminal locations. Cement stored by the Contractor for a period longer than 90 days shall be retested before being used in the work. Cement failing to meet any of the specified requirements at any time prior to incorporation into the work will be rejected and removed from the work. Cements of different types shall be stored separately.

**Shipping and Storage of Pozzolan Additives:** Pozzolan additives shall be shipped from only those sources approved by the Division. Bulk pozzolan additives shall be stored at the job site in weatherproof bins. Pozzolan additives from different sources or from different lots at the same source shall be stored separately.

### 501.2.1-Recycled Pavement for use as Coarse Aggregate for Concrete:

**501.2.1.1-**The existing portland cement concrete pavement may be removed and crushed, when called for on the Plans. If asphaltic concrete resurfacing is present, the asphaltic concrete shall be removed before the portland cement concrete is crushed.

**501.2.1.2-**Any existing reinforcing steel encountered shall be removed from the existing pavement prior to or during the crushing operation and shall be disposed of by the Contractor.

**501.2.1.3-**The Contractor shall remove the pavement in a manner which excludes subgrade and base material to the maximum extent practical.

**501.2.1.4-**The pavement material shall be crushed to pass the 1½ in. (37.5 mm) sieve. Processing equipment shall include a No. 4 (4.75 mm) screen and

excessive fines in the crushed material shall be controlled by removal of fines passing the No. 4 (4.75 mm) screen.

**501.2.1.5-**Any excess material removed during processing shall be disposed of by the Contractor.

## CONSTRUCTION METHODS

### 501.3-PROPORTIONING:

Prior to the start of construction, the Contractor shall design and submit to the Engineer for approval the proportions of materials, including admixtures, to be used which will result in a workable concrete having the properties enumerated below, including those of Table 501.3.1. The mix design, prepared in accordance with MP 711.03.23, shall include a statement giving the source of materials and certified test data from a Division approved laboratory demonstrating the adequacy of the mix design. The Contractor shall notify the Engineer of any change in the source of materials or the addition of admixtures during the process of the work since such change may necessitate a new mix design. The Contractor shall also state the  $\bar{A}$  value of the combined grading of the coarse aggregate, fine aggregate, and cement used in the mix design.

The combined grading of the coarse aggregate, fine aggregate, and cement used in the pavement concrete shall conform to the design mix  $\bar{A}$  plus or minus the tolerance specified in the following table for the coarse aggregate size used:

Coarse Aggregate Size No.	Design Mix $\bar{A}$ Tolerance
357 or 467	$\pm 0.35$
57 or 67	$\pm 0.25$

$\bar{A}$  is the values of total solids (coarse aggregate, fine aggregate and cement). The grading of the total solids shall be determined by the Contractor at least once each production day. Should the moving average of any five consecutive grading test results of the total solids have an  $\bar{A}$  outside the specified mix design tolerance limits, production shall be discontinued until appropriate corrections are made. Corrections shall be made either in the proportions of the concrete (the mix design), the gradation of the aggregates, or the storage and loading of the aggregate, as the Contractor may elect.

## 501.3.1

<b>TABLE 501.3.1 {ENGLISH}</b>			
<b>Minimum 28-Day Design Strength</b>	<b>Minimum Cement Factor</b>	<b>Maximum Water Content</b>	<b>Standard Size of Coarse Aggregate</b>
psi	Bags/ cu. Yd.	Gal. Per Cu. Yd. of concrete	Number
3,000 Compressive or 500 Flexural*	6**	33	357, 467  57 or 67
<b>TABLE 501.3.1 {METRIC}</b>			
<b>Minimum 28-Day Design Strength</b>	<b>Minimum Cement Factor</b>	<b>Maximum Water Content</b>	<b>Standard Size of Coarse Aggregate</b>
Mpa	kg per cubic meter	Liters per cubic meter of concrete	Number
20.7 Compressive or 3.5 Flexural*	335 kg**	163.4	357, 467  57 or 67

\*NOTE: Flexural strength when tested by the third point method.

\*\*NOTE: An equal volume of a pozzolanic additive may be substituted for portland cement up to the following maximum amount. Only one pozzolanic additive is permitted in a mix design.

**MATERIAL****QUANTITY**

Fly Ash	1 bag
Ground Granulated Blast Furnance Slag	3 bags
Microsilica	½ bag

MP 711.03.26 shall be used to control the cement factor in pavement concrete if the Contractor has a suitable means of verifying the minimum 28-day design strength, and providing a copy of the plan for verifying the strength is submitted to the Engineer. When MP 711.03.26 is used to control the cement factor in portland cement concrete pavements, then column two in Table 501.3.1 will be considered to contain a target cement factor instead of a

minimum cement factor.

The amount of entrained air in freshly mixed concrete shall be 7 percent plus or minus 2-½ percent.

Concrete shall have the consistency which will allow proper placement and consolidation in the required position. The optimum consistency shall be as indicated in Table 501.3.2.

<b>TABLE 501.3.2 CONSISTENCY</b>	
<b>TYPE</b>	<b>OPTIMUM CONSISTENCY</b>
	<b>INCHES (mm) OF SLUMP</b>
(a) For pavements when concrete is permitted to be placed using a slip form paver, where a low slump is required to maintain the prescribed geometry.	*1 in. (25 mm)
(b) For pavements supplied by travel mixers of central mixers where the concrete is struck off and consolidated entirely by mechanical equipment.	**2 in. (50 mm)
(c) For pavements and approaches supplied by travel, central or transit mixtures where the concrete is struck off and consolidated partially by hand labor.	**2 ½ in. (65 mm)

\*The consistency shall be that which will allow a proper placement and consolidation of the concrete, and will permit the prescribed geometry to be maintained. The concrete will be rejected when the consistency exceeds 2 inches (50 mm).

\*\*If the consistency exceeds the optimum plus ¾ in. (20 mm), the Contractor shall take immediate steps to reduce the slump of succeeding loads by making necessary adjustments in the mixture. The Contractor will be allowed a reasonable time for the trucks already on the road for a central mix or transit mix operation. Failure to comply will be cause for rejection of the concrete. If the consistency exceeds the optimum plus 2 inches (50 mm), the concrete will be rejected.

The approved mix design shall be subject to modification under the following conditions:

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After the start of the first concreting operation and immediately after the specified consistency and entrained air have been established, three unit weight determinations shall be made from different batches and the average of the three determinations shall be considered the unit weight of the concrete. The actual yield shall be adjusted as required to correct the actual yield to correspond to the theoretical.

During the progress of the work, the actual yield may be verified; and, if the yield based on a single unit weight determination should differ from the theoretical more than plus or minus two percent, two additional unit weight determinations shall be made from different batches and the average of the three determinations shall be considered the unit weight of the concrete. The actual yield shall be determined from the average unit weight, and the design mix shall again be adjusted as required to correct the actual yield to correspond to the theoretical.

In addition to the design mix adjustments specified above to correct for yield, other adjustments in the design mix proportions shall be made as necessary to maintain a plastic, workable mix with suitable finishing characteristics.

No change in the sources of material shall be made without prior approval of the Engineer.

Methods for determining the properties enumerated above shall be in accordance with 501.4.

### 501.4-TESTING:

#### 501.4.1-Test Methods:

Slump of Portland Cement Concrete	AASHTO T 119
Air Content of Freshly Mixed Concrete	AASHTO T 152 AASHTO T 196 with MP 711.03.20 or AASHTO T 199 with MP 711.03.25
Unit Weight/Yield of Concrete	AASHTO T 121
Making and Curing Concrete Compressive Specimens	AASHTO T 23 with MP 601.04.20
Flexural Strength Test Specimens in the Field and Compressive Strength of Cylindrical Concrete Specimens	AASHTO T 22
Flexural Strength of Concrete	AASHTO T 22

Obtaining and Testing Drilled Core Specimens	AASHTO T 97
Obtaining and Testing Drilled Core Specimens	AASHTO T 24
Measuring Length of Drilled Concrete Cores	AASHTO T 148
Total Moisture Content of Aggregate by Drying	AASHTO T 255
Sampling Fresh Concrete	AASHTO T 141
Sieve Analysis of Fine and Coarse Aggregates	AASHTO T 27 and T 11
Determination of Free Moisture in Fine Aggregate Using 20 Gram or 26 Gram “Speedy Moisture Tester”	MP 702.00.20
Sampling Aggregates	ML 26
Determination of Total Solids in Concrete	MP 601.03.51

**501.4.2-Contractor's Quality Control:** Quality control of the portland cement concrete is the responsibility of the Contractor as designed in MP 601.03.50. The Contractor shall maintain equipment and qualified personnel, including at least one certified portland cement concrete technician who shall direct all field inspection, sampling and testing necessary to determine the magnitude of the various properties of concrete governed by the Specifications and shall maintain these properties within the limits of this Specification. The Contractor’s personnel who conducts the field sampling and testing shall be a certified Portland Cement Concrete Inspector. The quality control plan designated by MP 601.03.50 shall be submitted to the Engineer at the preconstruction conference.

Item C5 of the Table 2.2.1 of MP 601.03.50 shall not apply to the Contractor's process control requirements for pavement concrete. Work shall not begin until the plan is reviewed for conformance with the contract documents.

**501.4.3-Acceptance Testing:** Acceptance sampling and testing of portland cement concrete is the responsibility of the Division, except for furnishing of necessary materials.

Strength, as used in this Specification, is only one indicator of the durability of the portland cement concrete. Evaluation of a pavement may include evaluation of the freeze-thaw durability, including scaling

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characteristics, abrasion resistance, density, and such other factors as the Division deems appropriate to the pavement.

**501.4.4-Testing for Opening Pavement to Traffic:** A minimum of three sets of three concrete specimens (beams or cylinders) each shall be made for each day's paving operation. The three sets of specimens shall be treated in the following manner to determine when the pavement represented may be put into service under the provisions of 501.18, except that said determination and the action permitted shall in no way affect the treatment of concrete as specified in 501.21.1 and 501.14.

One specimen from each of the three sets shall be tested at age four days and the results averaged to establish the test value. If the test value complies with the Specification, the portion of pavement which is aged four days may be put into service.

In the event Specification compliance has not been verified at age four days, one specimen from each of the three sets shall be tested at age six days and the results averaged to establish the test value. If the test value complies with the specifications the portion of pavement which is aged six days may be put into service.

In the event Specification compliance has not been verified at age six days, one specimen of the remaining specimen from each of the three set shall be tested at age eight days and the results averaged to establish the test value. If the test value complies with the Specification, the portion of pavement that has aged eight days may be put into service.

In the event the test value determined at age eight days does not comply with the Specification, the test values determined at ages four, six, and eight days may be plotted on a graph and a line drawn through the points in such a manner as to establish the age-strength relationship. The line may be projected to age 28 days, and if the projection indicates specification design strength compliance prior to age 28 days, then the pavement may be put into service at the age at which specification compliance is indicated.

When high early strength cement is used, the first test value may be established at age three days and all succeeding values established at 24 hour intervals.

**501.4.5-Compressive Strength Tests for Acceptance:** Compressive strength test for acceptance will be in accordance with the requirements prescribed.

The compressive strength of concrete will be determined by testing cores which are taken in the manner described in 501.19.1. These cores will generally be the same as those taken to verify pavement thickness and described in 501.19.2.

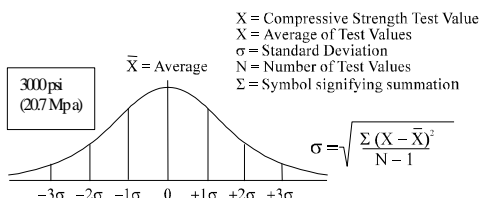
The concrete shall be at least 28 days old before the cores are obtained and generally the cores will be obtained before the concrete is 90 days old. Compressive strength test results obtained at time of test will be used in statistical analysis to verify compliance with the strength requirement.



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Compressive strength test data will be analyzed statistically and the average compressive strength minus one standard deviation shall be equal to or greater than the 28 day design strength ( $\bar{X} - 1SD \geq 28\text{-day design strength}$ , see graphical illustration below). Also, the average of any consecutive five strength tests representing a portion of the pavement concrete shall be equal to or greater than the 28-day design strength. Strength test data which are determined to be statistical outliers will be omitted from the computations which derive the statistical parameters ( $\bar{X}$  and  $\sigma$ ), and the sublots of pavement represented by outliers which occur in the region of low strength will be separately evaluated and disposed of in a manner deemed suitable by the Engineer.

#### NORMAL DISTRIBUTION CURVE (501.4.5)



If the specimens fail to meet the minimum standards of acceptance set forth above, the concrete in question will be considered substandard and disposition will be determined by the Division in accordance with 105.12 of these Specifications. If one or more sets of consecutive five strength tests should fail to comply with the Specifications and all other requirements of the Specifications are met, the portion of concrete represented by consecutive five sets which fail to comply will be considered substandard and the specified action will be related to the portion of concrete thus defined.

### 501.5-EQUIPMENT AND TOOLS:

Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined. Any equipment not maintained in satisfactory working order, or which is proved inadequate, shall be improved or new equipment substituted, as directed by the Engineer.

**501.5.1-Field Laboratory:** Portland cement concrete shall be supplied by a plant which has been certified by the Division as meeting all requirements of the governing Specifications and as having the facilities necessary to ascertain and control the quality of the product in accordance therewith.

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A testing facility or laboratory, as described below, shall be provided within reasonable proximity of the concrete batch patch.

The laboratory shall have inside dimensions which provide a minimum working area of 26 ft. (8 meters) in length by 6 ft. (2 meters) in width (examples which would generally meet this requirement are a building with inside dimensions of 12 by 13 ft.(3.5 by 4 meters), or a trailer with dimensions of 8 by 30 ft. (2.5 by 9 meters)). The laboratory shall be furnished and maintained with adequate ventilation, heat, light, water, sinks and drainage, electrical or gas outlets, or both, work table, shelves, and supply cabinets.

The laboratory shall be supplied with the equipment and materials listed below and shall be maintained in such a condition that the equipment will meet the applicable requirement of ASTM or AASHTO.

- i. Hot plate, gas or electric.
- ii. Large oven, gas or electric.
- iii. Pressure air meter or volumetric air meter (Rollameter).
- iv. Slump cone and rod.
- v. Unit weight container, ½ cu. ft. (0.014 m<sup>3</sup>)
- vi. Solution balance, 20 kg. capacity, one gram increments.
- vii. Balance, minimum capacity 1,000 g., 0.1 g. increments.
- viii. Platform scale, 100 kg. capacity, 10 g. increments.
- ix. Thermometer, armored type.
- x. Standard Gilson shaker or equivalent, with screens.
- xi. Ro-Tap shaker or equivalent, with 8-in. (200 mm) round screens.
- xii. Wire basket and container for weighing aggregates under water.
- xiii. Sample splitters for fine and coarse aggregates.
- xiv. Equipment for determining specific gravity of sand.
- xv. Miscellaneous items (including rubber hammer, mason's trowels, approximate dimensions 4 in. and 8 in. (100 mm and 200 mm), square point shovel, small and large sugar scoops, heavy galvanized pail approximate 14 qt. (13 liter) capacity, aggregate sample pans, brushes, flashlight, glassware, steel straightedge approximate dimensions 18 by 2 in. (450 by 50 mm)), and such expendable supplies as are necessary for the tests to be made.
- xvi. "Speedy Moisture Tester", 20 g. or 26 g. capacity.

### 501.5.2-Batching Plant Equipment:

**501.5.2.1-General:** The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a separate bin, hopper, and scale for cement shall be included. The weighing hopper shall be properly sealed and vented to preclude dusting during operation. If fly ash is used in the concrete, a separate bin shall be included.

**501.5.2.2-Bins and Hoppers:** Bins with adequate separate compartments

for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.

**501.5.2.3-Scales:** The scales for weighing aggregates and cement shall conform to the requirements of 109.1.

Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten 50 pound (22.68 kg) test weights for frequent testing of all scales.

Batching plants equipped to proportion aggregates and bulk cement by means of automatic weighing devices may be used.

**501.5.2.4-Water Measuring Equipment:** Unless the water is weighed, the water measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

**501.5.2.5-Admixture Dispenser:** A positive, automatic mechanical method shall be used for adding admixtures in solution.

### **501.5.3-Mixers and Hauling Equipment:**

**501.5.3.1-General:** Mixers at the site of construction or at central point, truck mixers, and hauling equipment shall conform to the requirements specified. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

**501.5.3.2-Mixers:** Mixing shall be in a mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period. The mixer shall be equipped with a timing device which will automatically lock the discharge level when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired.

The mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down  $\frac{3}{4}$  in. (20 mm) or more. The Contractor shall (1) have available at the job site a copy of the manufacturer's design showing dimensions and arrangements of blades in reference to original height and depth, or (2) provide permanent marks on blades to show points of  $\frac{3}{4}$  in. (20 mm) wear from new

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conditions. (Holes of ¼ in. (6 mm) diameter near each end and at a midpoint of each blade are recommended.)

**501.5.3.3-Truck Mixers and Truck Agitators:** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central-mixed concrete, shall conform to the requirements of AASHTO M 157.

**501.5.3.4-Nonagitator Trucks:** Bodies of nonagitating hauling equipment for concrete shall be smooth, mortartight, metal (non-aluminum) containers and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. The concrete shall be discharged from the bottom of the container. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle. Covers shall be provided when needed for protection.

**501.5.4-Finishing Machine:** The finishing machine shall be designed and operated to strike off, consolidate, and obtain a smooth finish. The top of the forms, if used, shall be kept free from accumulation by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true.

**501.5.5-Vibrators:** For full width vibration of concrete paving slabs, vibrators may be either the surface pan type or the internal type with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute, and the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and shall be between 5,000 and 10,000 impulses per minute for spud vibrators.

When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

Other types of vibrators may be used when shown they perform the function intended.

**501.5.6-Concrete Saw:** When sawing joints is elected or specified, the Contractor shall provide sawing equipment, adequate in number of units and power to complete the sawing to the required dimensions and at the required rate for preventing uncontrolled cracking. A standby saw and ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete pavement.

**501.5.7-Forms:** Straight side forms shall be of adequate design to support

the paving train and to provide the proper pavement section without horizontal joints. Flexible or curved forms of proper radius shall be used for curves of 200-ft. (60 meter) radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer. Forms shall be provided with adequate devices for secure setting and shall have an attachment provision for forming the keyed joint between lanes. When in place they shall withstand, without visible springing or settlement, the impact and vibration of consolidating and finishing equipment. Forms with battered top surfaces, and bent, twisted, or broken forms shall be removed from the job. The top face of the forms shall not vary from a true plane more than  $\frac{1}{8}$  in. (3 mm) in 10 ft. (3 mm in 3 meters), and the upstanding leg shall not vary more than  $\frac{1}{4}$  in. (6 mm) from a plane normal to the subgrade. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

**501.5.8-Edging Tools:** Edging tools shall have  $\frac{1}{4}$  in. (6 mm) radius for all edges except outside edges, which shall have a  $\frac{3}{4}$  in. (20 mm) radius.

## **501.6-PREPARATION OF GRADE, SETTING FORMS, AND CONDITIONING OF SUBGRADE OR BASE:**

**501.6.1-Preparation of Grade:** After the roadbed has been graded and compacted, as provided in 207 or 228, the grade shall be trimmed approximately to correct elevation, extending the work at least 2 ft. beyond each edge of the proposed concrete pavement to provide support for the fixed-forms or the slip-form paver tracks.

### **501.6.2-Setting Forms:**

**501.6.2.1-Base Support:** The foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade. Any grade which at the form line is found below established grade shall be filled to grade with granular material, in lifts of  $\frac{1}{2}$  in. (13 mm) or less for a distance of 18 in. (450 mm) on each side of the base of the form, and thoroughly compacted. Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

**501.6.2.2-Form Setting:** Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Form sections shall be tightly locked, free from play or movement in any direction. The forms shall not deviate from true line by more than  $\frac{1}{4}$  in. (6 mm) at any point. Excessive settlement or springing of forms under the finishing machine will not be tolerated. Forms shall be cleaned and oiled prior to the placing of concrete.

**501.6.2.3-Grade and Alignment:** The alignment and grade elevations of

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the forms shall be checked and corrections made by the Contractor prior to placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

**501.6.3-Conditioning of Subgrade or Base:** The base shall be brought to the proper cross section and plan grade within the tolerances specified for the final course underlying the pavement. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed. The grade shall be constructed sufficiently in advance of the paver to prevent delays.

Unless waterproof subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed.

### **501.7-HANDLING, MEASURING, AND BATCHING MATERIALS:**

The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work.

Stockpiles shall meet the requirements of 106.5. Aggregates shall be handled, hauled, and stored in such a manner which will minimize segregation, avoid contamination, and secure a uniform grading of the material within the specified gradation band. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining a sufficient time to eliminate excess water. Aggregates which have dried below a saturated surface-dry condition shall be wet down the night previous to their use, and sprinkled during the day to obtain saturated surface-dry condition.

The fine aggregate and each size of coarse aggregate shall be separately weighed into hoppers in the respective amounts approved by the Engineer for the job mix. Cement shall be measured by weight. Separate scales and hoppers shall be used for weighing the cement, with a device to indicate positively the complete discharge of the batch of cement. Bulk fly ash shall be stored in weatherproof bins. Batching shall be so conducted as to result in weights within a tolerance of one percent for cement and two percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over one percent.

All admixtures shall be measured into the mixer with an accuracy of plus or minus three percent. Admixtures shall be introduced into the mix simultaneously with the mixing water. When more than one type of admixture is used they shall be introduced into the mix separately.

Handling, measuring, and batching of materials for volumetric batching and continuous mixing shall, in addition to the preceding requirements, conform to the applicable requirements specified in AASHTO M 241.

### **501.8-MIXING CONCRETE:**

Concrete may be mixed at the site or a central mix plant, or it may be produced by volumetric batching and continuous mixing as designated in AASHTO M 241. When permitted in the Contract, concrete may be mixed in a truck-mixer.

Ready-mixed concrete shall be mixed and delivered in accordance with the

requirements of AASHTO M 157 paragraphs 10 and 11, or AASHTO M 241 paragraphs 7 and 8, except as otherwise specified.

The required minimum mixing time for an individual mixer may be specified as that which, as shown by tests made at the Contractor's expense, will result in satisfactory mixing. Performance tests and the acceptable ranges in test results within each batch from the three different samples are given in Table 501.8. The mixing time shall not be less than 75 seconds. Where mixer performance tests are not made, minimum mixing time shall be 60 seconds plus 15 additional seconds for each cubic yard (meter) of concrete being batched in excess of one cubic yard (meter).

The mixer shall be operated at a drum speed recommended by the manufacturer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at his expense. The mixer shall not be operated in excess of its nominal capacity as shown on the manufacturer's rating plate.

The mixing of concrete shall continue for the required mixing time after all ingredients, except water and admixture if added with water, are in the mixing compartment of the mixer before any part of the batch is released. The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the flow of materials into the drum.

The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor shall it exceed 60 minutes when hauled in transit-mix trucks or truck agitators.

The addition of water after the completion of the initial mixing operation will not be permitted, except that when concrete is delivered in transit-mix trucks additional water may be added to the batch materials and additional mixing (minimum of 20 revolutions at mixing speed) performed to modify the consistency to meet the specified requirements, provided all these operations are performed within 45 minutes after the initial mixing operation and provided the maximum number of revolutions at mixing speed is not exceeded. Concrete that is not within the specified consistency limits at the time of placement shall not be used.

No concrete shall be mixed, placed or finished when the natural light is insufficient unless an adequate artificial lighting system is used.

**TABLE 501.8**  
**PERFORMANCE TESTS AND ACCEPTABLE RANGES FOR**  
**CENTRAL MIXED CONCRETE**

<b>*TEST CRITERIA</b>	<b>**PERMISSIBLE RANGES WITHIN BATCH FROM THREE SAMPLES</b>
	<b>Plant</b>
Slump, in inches (mm)	2.25 (60 mm)
Air content, percent by volume of concrete sample	2.0
Weight per cu. ft. Of plastic concrete, in lbs.	4.0 (64.8 mm)
Coarse aggregate retained on No. 4 sieve expressed as a percent of three-sample average weight retained	11.0

\* Tests to be made in accordance with applicable AASHTO or ASTM Methods.

\*\* Each property measured shall not exceed the permissible range in more than one out of seven batches.

NOTE: Mixer performance data shall be based on three concrete samples per test batch, taken at the mixer during discharge from approximately 1/6, 1/2 and 5/6 points of the batch discharge.

Determination of coarse aggregate uniformity within the batch where concrete ingredients are batched from separate stockpiles of more than one size of coarse aggregate shall be made using sieves of appropriate size to identify the quantity of coarse aggregate coming from each of the separate stockpiles.

A minimum of seven production batches of concrete shall be tested for the proposed minimum mixing time unless the Engineer determines, on the basis of prior tests on concrete produced with the equipment and materials to be used, that a different number of batches is adequate for the purpose. When any change occurs in size of the batch, the operating process, conditions affecting mixing or hauling, the ingredients of the concrete, or other conditions which will affect the quality of the concrete incorporated in the pavement, an additional seven production batches of concrete shall be tested.

## **501.9-PLACING CONCRETE:**



The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible. Unless transit-mix trucks, agitators, or other hauling equipment units are equipped with means for discharge of concrete without segregation, the concrete shall be unloaded into a spreading device and mechanically spread on the grade in such manner as to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workers shall not be allowed to walk in the fresh concrete with boots or shoes coated with earth or foreign substances.

The pavement shall be constructed by placing two longitudinal traffic lanes full width in one operation unless otherwise indicated in the Contract. Lane-at-a-time construction will be permitted in variable width sections or other sections designated by the Engineer.

When the Contract permits lane-at-a-time construction and concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment other than finishing equipment will be operated upon the existing lane, that lane shall first meet the requirements of 501.18. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three days.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket onto a joint assembly unless the bucket is well centered on the joint assembly.

When using a slip-form paver, or combination of pavers, they shall be designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the paving train in such manner that a minimum of hand finishing will be necessary to provide a dense and homogenous pavement in conformance with the Plans and Specifications. The equipment shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. No appreciable edge slumping of the in-place concrete will be allowed, and, if necessary, forms shall be trailed behind the paver to prevent slumping. If training forms are used, they shall be rigidly supported laterally.

Slip-form pavers shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering and spreading concrete shall be so coordinated as to provide uniform progress. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

Placement to essential full width is required when slip-form paving methods are used. However, the Engineer may permit lane-at-a-time placement on variable width, small, or otherwise restricted sections using standard forming methods detailed elsewhere in these Specifications.

## **501.10**

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the equipment mounted vibrators be operated when the equipment is not moving in the forward direction. All equipment mounted vibrators shall be stopped, either manually or automatically, when the equipment stops its forward progress.

Should any concrete materials fall on, or be worked into, the surface of a completed slab, they shall be immediately removed.

### **501.10-STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT:**

Following placing, the concrete shall be struck off to conform to the cross section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after when the top layer of the concrete shall be placed, struck off, and screeded. All portions of the bottom layer which have been placed more than 30 minutes without being covered by the top layer shall be replaced at the Contractor's expense. When reinforced concrete pavement is placed in one layer, the reinforcement may be positioned in advance of concrete placement, or it may be placed in the plastic concrete, after spreading, by mechanical or vibratory means. When reinforcement is specified, it shall be placed in the center portion of the pavement. Variation in the depth of reinforcement is permitted, but the minimum concrete cover shall be one-third of the plan depth of the pavement.

Reinforcement shall be as designated on the Plans and shall be free from dirt, oil, paint, grease, and loose rust which could impair bond of the steel with the concrete.

### **501.11-JOINTS:**

Joints shall be constructed of the type and dimensions and at the locations required by the Plans.

**501.11.1-Longitudinal Joints:** Deformed steel tie bars or tie bolt assemblies shall be placed perpendicular to the longitudinal joints. They shall be placed by suitable mechanical equipment or rigidly secured by suitable supports to prevent displacement. Tie bars shall not be painted, coated, or enclosed in tubes or sleeves.

All longitudinal joints shall be sawed normal to the surface of the pavement with a suitable concrete saw. Construction of longitudinal joints shall be in accordance with the appropriate requirements, as follows:

- i. When the longitudinal joint separates adjacent pavement lanes or slabs that are poured at the same time, sawing of longitudinal joints shall be performed between 4 and 24 hours after the pavement is placed and before any equipment and vehicles are allowed on the pavement. The saw cut shall be to a minimum depth of one-third of the plan depth of pavement; the width shall be  $\frac{1}{4}$  in. (6 mm), with a tolerance of plus or minus  $\frac{1}{16}$  in. (2 mm) The groove shall be cleaned and cured in accordance with 501.11.8 and sealed in accordance with 501.16.
- ii. When the longitudinal joint separates adjacent pavement lanes or slabs that are poured separately (lane-at-a-time construction), the longitudinal joint may be sawed, and cleaned in accordance with 501.11.8, just prior to sealing in accordance with 501.16. The saw cut shall be to a depth of 1 in. (25 mm), plus  $\frac{1}{4}$  in. (6 mm); the width shall be  $\frac{1}{4}$  in. (6 mm) plus or minus  $\frac{1}{16}$  in. (2 mm) If the joint is not sealed soon after the sawing operation, the groove shall be protected in accordance with 501.11.8 until just prior to the sealing operation.

When formed joints are permitted, they shall be formed while the concrete is in the plastic state by a suitable mechanically operated device. The joints shall be formed to the dimensions and lines indicated on the Plans. The groove shall be sealed in accordance with 501.16.

The longitudinal joints shall extend to and contact the transverse joints, if any.

**501.11.2-Transverse Expansion Joints:** The expansion joint filler shall be one piece, continuous from form to form, shaped to the subgrade and to the cross section of concrete. The filler shall be depressed  $\frac{1}{2}$  in. (13 mm) below the surface of the pavement.

The expansion joint filler shall be held in a vertical position. Finished joints shall not deviate more than  $\frac{1}{4}$  in. (6 mm) in the horizontal alignment from a straight line at right angles to the centerline of the pavement. No plugs of concrete will be permitted anywhere within the expansion space.

**501.11.3-Transverse Contraction Joints:** Transverse contraction joints shall consist of planes of weakness created by sawing or forming grooves, normal to the grade, in the surface of the pavement as shown on the Plans. These contraction joint grooves shall be centered, within 1 in. (25 mm) of the mid-length of the dowels, over the coated dowel bars specified.

Unless otherwise specified or authorized, all transverse contraction joint grooves shall be constructed in two steps as described, resulting in the dimensions detailed on the Plans and at the spacing and locations shown on the Plans. Grooves shall be cured in accordance with 501.11.8 and sealed in accordance with 501.16.

#### 501.11.4

As soon as feasible after placing the concrete, the contraction joints shall be sawed or formed to the dimensions shown on the Plans. Initial sawing of joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excess raveling, usually 4 to 24 hours. All joints shall be initially sawed before uncontrolled shrinkage cracking takes place, but no later than 24 hours after placement of concrete. If necessary, initial sawing operations shall be continuous, through day and night, regardless of weather conditions. In general, all joints should be sawed in sequence. The initial sawing of any joint shall be omitted if cracking occurs at or near the joint location prior to the time of sawing. Initial sawing of a joint shall be discontinued when a crack develops ahead of the saw. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, the contraction joints shall be formed in the plastic concrete.

When the concrete has hardened sufficiently, but no earlier than 72 hours after placement of the concrete, final or second-step sawing shall be performed. The sawing operation shall consist of widening the contraction joint to the depth and width shown on the Plans and shall be conducted in such a manner as to provide smooth and uniform joint faces.

After the joints have been cleaned, following second-step sawing, they shall be inspected for irregularities. Any excessive irregularities of the joint faces, including spalled, cracked and honey combed areas or otherwise loose, unsound concrete, which would prevent proper contact between the sides of the seal and the joint faces, shall be corrected prior to installation of the seal. The loose, unsound concrete shall first be removed to the satisfaction of the Engineer. The damaged area shall then be repaired in an acceptable manner. For elastomeric seals, when a joint opening is larger than the specified width plus the allowable tolerance, which can be attributed to inaccurate sawing rather than contraction of the abutting slabs, the joint shall be "built up" with an acceptable epoxy resin mortar mix to its proper width. The concrete surface shall be clean and dry at the time of placing the epoxy mortar. All joint repair work shall be done at the Contractor's expense and to the satisfaction of the Engineer.

When formed joints are permitted, they shall be effected by an approved mechanically operated device to the dimensions specified and while the concrete is still in the plastic state. The grooves shall be filled as specified or, if forming is in lieu of initial sawing, shall be later widened by second-step sawing.

Random cracking at transverse contraction joints, as described in 501.11.7, shall be sealed with silicone sealant.

**501.11.4-Transverse Construction Joints:** Transverse construction joints shall be installed when there is an interruption of more than 30 minutes in the concreting operations. No construction joint shall be installed within 10 ft. (3 meters) of an expansion or contraction joint. If sufficient concrete has not been placed to form a slab at least 10 ft. (3 meters) long, the excess concrete back to the last proceeding joint shall be removed.

Construction joints shall be constructed in a manner similar to transverse

contraction joints. The groove for installation of the sealant shall have the same dimensions as for transverse contraction joints and shall be sealed in accordance with 501.16.

**501.11.5-Coated Dowel Bars:** Coated dowel bars (load transfer reinforcement) shall be used across all transverse joints as shown on the Plans. Dowels shall be located at mid-depth of the pavement with a tolerance of placement within plus or minus 1 in. (25 mm) of the lateral and vertical positions shown on the Plans. Dowels shall be aligned parallel to the centerline and surface of the pavement with a tolerance for such alignments within plus or minus ¼ in. (6 mm) per dowel.

Dowels shall be held in position in the pavement by means of metal supports that remain in the pavement, except as noted. The combination of dowel bars and all the various components of the metal supports at a joint is commonly referred to as the dowel assembly or load transfer unit. Welding of dowels to the supports, to achieve a fixed end condition, shall be performed in accordance with the details shown on the Plans. For dowel assemblies at contraction and construction joints, welding of dowels to any member of the supports will not be permitted within the middle one-third of the dowel's length. The longitudinal misalignment of one end of a dowel assembly with respect to the other end in achieving a perpendicular alignment with the centerline of the pavement shall not exceed 1 in. (25 mm). Acceptance of a type of dowel assembly by the Division in no way relieves the Contractor of their responsibility for furnishing, as part of the assembly, coated dowel bars that meet the requirements of 709.15, nor does it relieve the Contractor of the Contractor's responsibility for placing and maintaining the assembly in its proper position and alignment during paving operations.

The mechanical implanting method of placing dowel bars is not permitted except when approved by the Engineer.

For coated dowel bar types that require a bond breaker, the bond breaking material, prequalified for use with that particular type coating, shall be carefully applied over the entire length of the bar just prior to placement of concrete unless an approved bondbreaker lubricant has been applied in the shop.

The free end of expansion joint dowels shall be provided with a close fitting metal cap or sleeve equipped with a stop to prevent closing during paving operations. A clearance of 1 in. (25 mm) shall be maintained between the closed end of the cap and the end of the dowel to accommodate future movement of the concrete slab.

**501.11.6-Expansion Joints Around Structures:** Expansion joints shall be formed by placing pre-molded expansion joint material about all structures and features projecting through, into or against the pavement. Unless otherwise indicated, such joints shall be ½ in. (13 mm) in width.

**501.11.7-Random Cracks:** Random cracks falling in an area 3 inches (75 mm) on either side of the center of the transverse contraction joint's dowel bars

### **501.11.8**

shall be sawed for the full width, widening and deepening the crack to the dimensions of final or second-step sawing for transverse contraction joints, of the pavement slab and cleaned, just prior to sealing with silicone sealant.

If any random or uncontrolled crack occurs between 3 inches (75 mm) and 10 ft. (3 meters) from a doweled joint, the entire pavement within the lane where such crack occurs shall be removed for a distance of 10 ft. (3 meters) from the joint and replaced. If such cracking occurs on both sides of the same joint, the pavement shall be removed for a distance of 10 ft. (3 meters) in both directions. The dowel assembly or bars, as the case may be, shall be removed and replaced with a new dowel assembly. The new joint over the dowel assembly shall be initially formed by the use of a removable insert or by sawing and the joint later widened by second-step sawing for sealing in accordance with 501.16. The above described work shall be done at no additional cost to the Division.

**501.11.8 – Curing Saw Joints:** Immediately upon completion of the final sawing operation both vertical faces shall be completely free of dirt and dust; leaving a clean, dry, newly exposed concrete surface. Joints shall be cleaned by sandblasting each face with the nozzle held at an angle to the joint face and within 1 or 2 inches (25 to 50 mm) of the pavement. Sandblasting shall be done to a depth at which the sealant and backer rod are to be installed.

No sealant shall be placed unless temperature of the air and the pavement is 40° F (4° C) or higher.

**501.11.8.1-Rope or Rod:** After the joint is cleaned, acceptable rope or rod material which is non-metallic, inert, resilient, compressible, non-absorbent and non-shrinking shall be installed along the top of the joint, flush with the pavement surface, and shall also extend down the pavement edge to the bottom of the joint. The diameter of the rope or rod material shall be approximately 25 percent larger than the joint width.

The rope or rod material shall remain in the joint until just prior to the second-step sawing or, for longitudinal joints, until just prior to sealing. When sealing operations for transverse contraction or construction joints do not commence immediately after the second-step sawing and cleaning, a rope or rod approximately 25 percent larger than the joint width shall be installed as previously specified and shall remain in place until just prior to sealing.

### **501.11.9-Bridge Approach Expansion Joints for Jointed Pavement:**

Construction of bridge approach expansion joints for jointed pavement shall be performed at the locations and in accordance with the details and requirements specified on the Plans. Construction of the concrete sub-slab may be Class B of 601 or pavement concrete. Construction of the bituminous concrete courses shall conform to the applicable requirements of 401.

## **501.12-FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING:**

**501.12.1-Sequence:** The sequence of operations shall be strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish.

Any addition of water to the surface of the concrete to assist in the finishing operations will not be permitted. When conditions are such that unusually rapid drying is occurring, an atomized mist may be used to prevent the rapid evaporation of water from the concrete surface during the final finishing.

**501.12.2-Finishing at Joints:** The concrete adjacent to joints shall be consolidated or firmly placed without voids or segregation against the joint material, under and around all load transfer devices, joint assemblies, and other features designed to extend into the pavement. Concrete adjacent to the joints shall be mechanically vibrated as required in 501.9.

The operation of the finishing machine over the joints shall not cause segregation of concrete and damage to or misalignment of joints.

**501.12.3-Machine Finishing:** The concrete shall be distributed as soon as placed. It shall immediately be struck off and screeded by the finishing machine.

Vibrators for full width vibration of concrete paving slab shall meet the requirements of 501.5.5. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and methods which will produce pavement conforming to the Specifications.

**501.12.4-Hand Finishing and Consolidation:** Hand finishing will not be permitted except under the following conditions:

In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade.

Areas of narrow widths or irregular dimensions, where operation of mechanical equipment is impractical, may be finished by hand.

Concrete, as soon as placed, shall be struck off and screeded. A portable screed shall be used.

If reinforcement is used, a second screed shall be provided for striking off the bottom layer of concrete.

The surface screed shall be at least 2 ft. longer than the maximum width of slab to be struck off. It shall be sufficiently rigid to retain its shape under all working conditions, and constructed either of metal or of other suitable material shod with metal.

Consolidation shall be attained by the use of suitable vibrator or other equipment.

In operation the screed shall be moved forward on the forms in the direction the work is progressing, using a combined longitudinal and transverse shearing motion, so manipulated that neither end is raised from the side forms during the striking process. This shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

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**501.12.5-Floating:** After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a mechanical longitudinal float, except when waived by the Engineer.

If necessary, following one of the methods of floating described, long-handled floats may be used to smooth and fill in open textured areas in the pavement. Care shall be taken not to work the crown out of the pavement during the operation.

**501.12.5.1-Mechanical Method:** The mechanical longitudinal float shall be maintained in proper working order. At the beginning of each day's operation the float shall be checked and adjusted to the design crown of the pavement. A small amount of mortar shall be carried ahead of the float at all times. The forward speed shall be adjusted so that succeeding strokes of the float shall overlap on each transverse trip. The float shall pass over each area of pavement sufficient number of times until the surface shows no variation from straightedge requirements, but excessive operation over a given area will not be permitted. All excess water, laitance, or other foreign material shall be wasted over the side forms on each pass.

Pipe float devices may be used for longitudinal floating when slipform paving.

**501.12.5.2-Alternative Mechanical Method:** As an alternate to the above method, the Contractor may use a machine composed of a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. The frame shall be carried by at least four visible wheels riding on, and constantly in contact with, the side forms.

**501.12.5.3-Hand Method:** The hand-operated longitudinal float shall be not less than 12 ft. in length and 6 inches (150 mm) in width, properly stiffened to prevent flexibility and warping. The float shall be operated from foot bridges resting on the side forms and spanning but not touching the concrete.

The float shall be worked with a sawing motion, while held in a floating position parallel to the road centerline and passing gradually from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water, laitance, and other foreign material shall be wasted over the side forms on each pass.

**501.12.6-Straightedge Checking and Surface Correction:** After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 10-ft straightedge. The Contractor shall furnish and use a 10-ft straightedge swung from handles at least 3 ft. longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over



from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than one-half the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meet the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross section.

**501.12.7-Final Finish:** The surface of the mainline pavement, acceleration and deceleration lanes, ramps, and all traveled ways shall be given a final groove finish. The tool used shall produce a groove that is approximately 3/32 in. (2 mm) wide. The depth of the groove shall be 1/8 in. (3 mm) to 3/16 in. (5 mm) and spaced approximately 1/2 in. (13 mm) center to center. The grooves shall be formed in a direction transverse to the centerline of the roadway. Adjacent strokes to establish the texture shall abut one another without appreciable overlap. Texturing shall be performed when the concrete surface is of such plasticity as to prevent excessive raveling (concrete too dry) or to prevent mortar from flowing back into the grooves (concrete too wet). All texturing shall be accomplished with a single pass of the tool.

**501.12.8-Edging at Forms and Joints:** Before the concrete has taken its initial set, the edges of the pavement along each side of the slab and on each side of all formed joints, except joints initially formed that will be later widened by second-step sawing, shall be rounded. A 3/4 in. (20 mm) radius edging tool shall be used for rounding outside edges and a 1/4 in. (6 mm) radius tool for other edges. A well defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during use. Any tool marks shall be eliminated by brooming the surface without disturbing the radius. All concrete on top of the joint filler shall be removed.

All joints shall be checked with a straightedge before the concrete has set and all necessary corrections made if one side is higher than the other or if they are higher or lower than the adjacent slabs.

**501.12.9-Station Numbers:** The Contractor shall impress station numbers into the pavement before it takes its final set. The complete station number is to be marked each 100 ft. (20 meters) Where equalities in alignment occur, they shall be marked in the pavement in the same manner as they are shown on the Plans. The numerals shall be 3 to 4 inches (75 to 100 mm) in height and 1/4 in. (6 mm) in depth. The station numbers shall be placed parallel to the transverse joints, approximately 12 to 24 inches (300 to 600 mm) from the outside edge of the pavement. Station numbers shall be placed along the right edge of a two-lane highway, readable in the direction of increasing stations. On multi-lane highways, numbers shall be placed along the outside edge of the two

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outside lanes of the roadway, readable in the direction of travel.

**501.12.10-Protection Against Rain:** In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor shall have available at all times materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of metal forms or wood planks having a nominal thickness of not less than 2 inches (50 mm) and nominal width of not less than the thickness of the pavement at its edge for protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting for protection of the surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

#### 501.13-SURFACE TESTS:

The smoothness of the riding surface will be determined by the engineer using an inertial Profilometer or Mays Ride Meter calibrated to an inertial Profilometer. The smoothness testing will generally be accomplished within 30 days after the project is complete.

**501.13.1 – Sampling Units:** The pavement will be divided into sampling LOTS of 0.1 lane mile (0.16 lane kilometer) each. Each LOT shall exhibit a smoothness measurement, expressed in inches per mile (millimeters per kilometer).

**501.13.2 – Smoothness Requirement:** Each sampling unit shall exhibit a smoothness equal to or less than 65 inches per mile (1000 millimeters per kilometer). Sampling units exhibiting smoothness values greater than 65 inches per mile (1000 millimeters per kilometer) shall be paid for at an adjusted price as follows:

$$\begin{aligned}\text{Revised Unit Price} &= \text{UBP} - \left[ \left( 1.00 - \left\{ \frac{127.86 - 0.429S}{100} \right\} \right) (0.18 \text{ UBP}) \right] \text{ ENGLISH} \\ &= \text{UBP} - \left[ \left( 1.00 - \left\{ \frac{127.86 - 0.028S}{100} \right\} \right) (0.18 \text{ UBP}) \right] \text{ METRIC}\end{aligned}$$

Where UBP = Unit Bid Price

Where S = Smoothness in inches per mile (millimeters per kilometer)

When the measured smoothness value exceeds the specified value by 50 percent or more, the LOT shall be corrected to comply with these specifications.

#### 501.14-CURING:

Immediately after the finishing operations have been completed and as soon

as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with one of the methods described. In all cases in which curing requires the use of water, the curing shall have prior right to the use of all water supplies. Failure to provide sufficient curing materials of whatever kind the Contractor may elect to use will be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 30 minutes between stages of curing or during the curing period.

Concrete placed in cold weather, as defined in 501.21, shall be cured a minimum of seven calendar days or when the Contractor provides suitable means for documenting the maturity (degree-hours) of the concrete, based on slab surface temperature, the curing period may be terminated when the curing has been maintained for a minimum of 7,000 degree hours.

During the curing period the surface temperature of the concrete shall not be allowed to fall below freezing. The Contractor shall be responsible for the quality of the concrete placed or cured, or both, during cold weather. Any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

Polyethylene coated burlap and white polyethylene sheeting will be permitted as a curing application only on areas where intimate contact with the concrete surface can be obtained and maintained.

**501.14.1-Burlap Mats:** The surface of the pavement shall be entirely covered with the mats. The mats shall be of such length that they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and both edges of the slab are completely covered. Before placing, the mats shall be thoroughly saturated with water. The mats shall be weighted down so as to remain in intimate contact with the surface covered and shall be maintained fully wetted and in position for 72 hours after the concrete has been placed, unless otherwise specified.

**501.14.2-Waterproof Paper:** The top surface and sides of the pavement shall be entirely covered with waterproof paper. The units shall be lapped at least 18 in. (450 mm). The paper shall be weighted down so as to remain in intimate contact with the surface. Each unit as laid shall extend at least twice the thickness of the pavement beyond the edges of the slab. Paper not manufactured in sizes providing this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up during curing. The surface shall be thoroughly wetted before placing the paper. Curing shall continue for 72 hours after the concrete is placed, unless otherwise specified.

**501.14.3-Straw Curing:** When this type of curing is used, the pavement shall be cured initially with burlap or cotton mats, as specified above, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the mats are removed, the surface and sides of the pavement shall

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be thoroughly wetted and covered with at least 8 inches (200 mm) of straw or hay, thickness to be measured after wetting. The straw or hay shall be kept thoroughly saturated with water for 72 hours after placing the concrete. If the straw or hay becomes displaced during the curing period, it shall be replaced to the original depth and saturated. Upon removal, the covering shall be disposed of in such a manner as to leave the right-of-way in a neat condition. The straw or hay shall not be burned on, or adjacent to, the pavement.

**501.14.4-White Pigmented Impervious Membrane:** The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing operation and before initial set has taken place, or, if the pavement is initially cured with burlap or cotton mats, it may be applied upon removal of the mats. The curing compound shall not be applied during rainfall.

Curing compound shall be applied under pressure by mechanical sprayers. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. The rate of application of the curing compound shall be as follows:

Pavement with Burlap Drag Finish-One Gallon Per Maximum of 150 sq. ft. (0.27 liters per square meter)

Pavement Requiring Groove Finish-One Gallon Per Maximum of 125 sq. ft. (0.33 liters per square meter)

At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be continuously agitated. Hand spraying of odd widths or shapes and surfaces exposed by removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed.

Should the film become damaged from any cause within the required curing period (72 hours after placement of concrete, unless otherwise specified), the damaged portions shall be immediately repaired with additional compound.

Upon removal of the side forms, the sides of the exposed slabs shall be protected immediately with a curing treatment equal to that provided for the surface.

#### **501.14.5-White Polyethylene Sheeting or Polyethylene Coated Burlap:**

The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting or polyethylene coated burlap. Units shall be lapped at least 18 in. (450 mm) The covering shall be weighed down so as to remain in intimate contact with the surface covered. The covering shall extend at least twice the thickness of the pavement beyond the edges of the slab. The covering shall be maintained in place at least 72 hours after the concrete is placed, unless otherwise specified.

#### **501.15-REMOVING FORMS:**

Forms shall not be removed until at least 12 hours after placement of the concrete. Forms shall be removed carefully so as to avoid damage to the slab. As soon as the side forms have been removed, minor honeycombed areas shall be filled with mortar composed of one part cement to two parts fine sand and cured as outlined in one of the methods indicated above. Major honeycombed areas shall be removed and replaced. All areas or sections so removed shall be not less than 10-ft in length nor less than the full width of the traffic lane involved. Any remaining portion of the slab adjacent to the joints that is less than 10-ft in length shall also be removed and replaced. Slabs shall be cut by sawing full depth for removal.

#### **501.16-SEALING JOINTS:**

All transverse contraction and construction joints to be sealed shall have the preformed elastomeric seal installed or shall be filled with silicone sealer before the pavement is opened to traffic, including construction traffic, and as soon after completion of curing as is feasible.

All longitudinal joints shall be sealed with silicone sealant.

**501.16.1-Silicone Sealant:** Following forming, initial sawing and final or second-step sawing operations, the joints shall have been cleaned in accordance with 501.11.8. In preparation for sealing, all joints that have become contaminated since those forming or sawing operations shall be cleaned by wire brushing, sandblasting, or a high pressure water blast or by a combination of these methods.

Just prior to installing the back-up material, the joints shall be blown out with compressed air at a pressure of at least 90 psi (620 kPa) to remove all dust, loose particles and debris. Air compressors used for this purpose shall be equipped with traps capable of removing moisture and oil from the compressed air. A joint shall not be sealed until it is thoroughly clean and dry.

When recommended by the manufacturer, the vertical surfaces of joints shall be fully wetted by a primer. The primer and application, including all safety precautions, shall be as per the manufacturer's recommendations. The primer shall be allowed to dry tack-free prior to installation of the backer rod.

The back-up material shall be installed in the joint at the required depth. The silicone sealant shall then be applied from inside the joint in a manner which causes it to wet the joint faces and to reasonable close conformity with the required dimensions.

Immediately following placement of the sealant and before a skin forms, the sealant shall be tooled to force it against the joint faces and to provide a slightly concave surface with a depth of approximately 3 in. (6 mm) (at the center of the joint) below the pavement surface.

Any unreasonable deviation from the required joint or sealant dimensions will be just cause for rejection of the joint until satisfactory corrective measures are taken by the Contractor at no additional cost to the Division. Any failure of the joint material in either adhesion or cohesion will be cause for rejection of the joint, and the joint shall be repaired to the Engineer's satisfaction by the

### **501.16.2**

Contractor at no additional cost to the Division.

Silicone sealant shall never be applied to frozen, dirty, wet, or damp concrete or during inclement weather conditions. Silicone sealant shall not be placed in the joints without the approval of the Engineer when the temperature at the surface of the concrete is less than 40° F (5° C).

**501.16.2-Performed Elastomeric Seal:** The dimensional requirements shall be as specified on the Plans. Joints shall be clean and dry at the time the elastomeric seal is installed. Just prior to installation of the seal, the lubricant-adhesive shall be applied to the joint faces or the sides of the seal, or both, to facilitate installation of the seal and to help secure the seal in place in the joint. The lubricant-adhesive shall be applied in such a manner as to cover both sides of the seal over the full area in contact with the joint faces. Any lubricant-adhesive that gets on top of the seal shall be immediately removed. Seals shall be installed in a substantially full compressed condition with the vertical axis of the seal parallel to the joint faces. Seals shall be installed in the joints to the depth shown on the Plans using suitable machines or tools that will not twist, curl, nick, notch, or otherwise damage the seal and that will insert the seal in such a manner that elongation of the seal shall not exceed five percent. The in-place seals shall be one-piece construction, without field or factory splices, for the full length of the joint. Any seal that is damaged during installation shall be removed and replaced with a new, undamaged seal. Any seal that is improperly installed or positioned in the joint or that shows more than five percent elongated following installation shall be removed and properly reinstalled or replaced.

### **501.17-PROTECTION OF PAVEMENT:**

The Contractor shall protect the pavement and its appurtenances against both public traffic and the traffic caused by their own employees and agents.

This protection shall include watchmen to direct traffic, and the erection and maintenance of warning signs, lights, barricades, pavement bridges, crossovers, etc. The above shall be arranged so as not to interfere with public traffic on any lane intended to be kept open.

All damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced, as the Engineer may direct.

### **501.18-OPENING PAVEMENT TO TRAFFIC:**

If approved by the Engineer, the Contractor may open the pavement to traffic prior to 28 days after placement of concrete, provided tests conducted in accordance with 501.4.4 indicate the pavement has attained the 28-day design strength. If the Contractor wishes to open pavement to traffic prior to age 28 days, then all provisions for making test specimens and conducting and reporting the tests shall be handled by the Contractor at their expense. However, the Engineer may require that the pavement not be opened to traffic for a period of 28 days or longer, after placement of concrete, if conditions make it advisable to extend this time.

**501.19-TOLERANCE IN PAVEMENT THICKNESS:**

It is the intent of these Specifications that the pavement shall be constructed in substantial conformity with the specified thickness. Paving operations shall be directed toward obtaining an average and uniform thickness equal to or greater than the specified thickness.

For the purpose of establishing an adjusted unit price for pavement areas deficient in thickness, the thickness characteristics will be determined in accordance with the criteria specified.

**501.19.1-Sampling Units and Sampling Requirements:** The pavement thickness characteristics will be determined from an analysis of measurements made on cores. The cores will be taken by the Division with a frequency of one core from each sampling unit as defined and will be analyzed in accordance with [501.23.1.1](#).

**501.19.1.1-Highway Proper:** The total length of paving lane in linear feet in the highway proper shall be divided by 500 to determine the largest whole number which shall be the number of sampling units in the highway proper. The width of the sampling unit shall be the width of the paving lane, and the length of the sampling unit shall be determined by dividing the total length of paving lane in linear feet in the highway proper by the number of sampling units determined in the manner set forth. When paving lane width exceeds 24 ft. (7.2 meters), the Division may establish shorter sampling units.

When the number as determined above is less than 10, the total length of the paving lane in linear feet shall be divided into 10 equal sampling units.

**501.19.1.2-Auxiliary Features:** Intersections, entrances, exits, crossovers, ramps, etc., may be considered individually or collectively so as to form sampling units most nearly the length previously established in the highway proper.

**501.19.2-Deficient Thickness (Detection and Delineation):** One core will be taken from each sampling unit and the length of the core will represent the thickness of the unit.

When a sampling unit is represented by a core measurement which is less than the specified thickness minus 7.8%T.  $T - 7.8\%T$ , the sampling unit will be evaluated as set forth in [501.19.2.1](#).

**501.19.2.1** - The part of the sampling unit considered to be deficient in thickness by  $T - 7.8\%T$  or more will be delineated by taking additional cores at approximately 20 ft. (6 meter) intervals, parallel to the centerline, in each direction from the core obtained in [501.19.2](#), until a core is obtained, in each direction, which is not deficient in length by more than  $T - 7.8\%T$ . Areas thus defined shall be removed and replaced at no additional cost to the Division. These exploratory cores will not be used in the analysis of the remainder of the

### **501.19.3**

unit. The balance of the sampling unit will be treated as a separate sampling unit.

One additional core will be obtained from the balance of the sampling unit to represent the unit. The thickness represented by this core, when greater than T-7.8%T, will be included in the measurements specified in [501.23.1.1](#).

**501.19.3-Refilling of Cores:** As soon as directions are issued by the Engineer, the Contractor shall refill and properly cure all test holes at no additional cost to the Division.

### **501.20-PAVEMENT WIDENING:**

When called for on the Plans or directed by the Engineer to widen an existing pavement by means of strips of portland cement concrete, on one or both sides, the construction methods and materials shall be as specified for regular portland cement concrete pavement, except as modified.

- i. Compaction of the fine grade may be by means of an approved special roller capable of exerting a compressive force of not less than 100 lb. per in. (1.8 kg per mm) of width and as further prescribed in [207.9](#).
- ii. Forms may be of steel or wood. They shall be secured as required by the Engineer.

### **501.21-ADVERSE WEATHER CONDITIONS:**

**501.21.1-Cold Weather Concreting:** When the component materials are not artificially heated and the temperature of the plastic concrete becomes less than 55° F (13° C), the provisions for cold weather concreting shall apply. The concrete shall have a temperature of at least 50° F (10° C) but not more than 85° F (30° C). This temperature shall be maintained by heating the water or aggregate, or both, as necessary. Heating methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used. The equipment shall be capable of heating materials uniformly. Aggregates or water shall not be heated to a temperature exceeding 150° F (65° C). Stockpiled aggregate may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or oil flame or on sheet metal over fire. Binned aggregates may be heated by steam-coil or water-coil heating. The use of live steam on or through binned aggregates will not be permitted.

If the Contractor is placing concrete or plans to place concrete during cold weather conditions, the Contractor shall advise the Division of their plans for curing and protecting the concrete. The Division may, at any time, require the Contractor to provide additional protection to cause the provisions of this Specification to be met. When concrete is being placed and the air temperature is expected to fall below 35° F (2° C), a sufficient supply of suitable blanketing material shall be provided. Any time the air temperature is expected to reach the freezing point during the day of placement or the following night, the



material so provided shall be spread over the pavement to a sufficient thickness to prevent freezing of the concrete. The material shall be covered or otherwise secured to insure that it will remain in place for the duration of the curing period.

No concrete shall be placed on a frozen subgrade. Materials containing frost or lumps of frozen material shall not be used.

**501.21.2-Hot Weather Concreting:** The Contractor will be required to state, at the pre-construction conference, their plan of action when the temperature of plastic concrete reaches 90° F (32° C).

When a shaded thermometer in the vicinity of the production plant reaches 85° F (30° C), thermometer readings of the temperature of the plastic concrete shall be taken at least once per hour.

When the temperature of the plastic concrete reaches 85° F (30° C), the elapsed time between the introduction of the mixing water to the cement-aggregates and discharge of the mix shall not exceed 45 minutes. At this temperature or above, particular attention shall be paid to the Specification provisions concerning the sprinkling and wetting of subgrade and forms, the maintenance of coarse aggregate stock in saturated surface-dry condition, and the prompt start of concrete curing operations.

When the temperature of the plastic concrete reaches 90° F (32° C), immediate steps shall be taken to cool either mixing water or aggregates, or both, in order to maintain a plastic concrete temperature of 90° F (32° C), or less. Crushed or flaked ice may be used to cool the mixing water. Crushed or flaked ice may also be introduced into the mixing drum when the concrete is batched and mixed in a truck mixer. The ice will be considered as part of the mix water in the mix proportions. The mixing operation shall not be considered complete until all ice in the drum has melted.

In no event shall concrete be placed when its temperature in the plastic state, at the completion of mixing, exceeds 90° F (32° C).

## **501.22-METHOD OF MEASUREMENT:**

The quantity of concrete pavement to be paid for will be the number of square yards (meters) complete in place and accepted. The width for measurement will be the width of the pavement shown on the typical cross section of the Plans and additional widening where called for or as otherwise directed in writing by the Engineer. The length will be measured on the surface along the centerline of each roadway ramp.

Bridge approach expansion joints will be measured separately and shall be the actual number of joints constructed, complete in place and accepted.

In contracts where only widening is called for, the square yards (meters) of pavement widening will be determined from the length of strips, measured along the edges and upon the surface, times the width as measured at regular intervals, plus the area of any widening on curves, turnouts or intersections authorized and measured separately.

No extra payment will be made for removing and crushing the existing

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pavement for use as coarse aggregate for concrete.

### **501.23-BASIS OF PAYMENT:**

**501.23.1-General:** The quantities, determined as provided above, will be paid for at the contract unit prices less adjustments referred to below, which shall constitute full compensation for furnishing and preparing of all materials, including reinforcing steel, transverse and longitudinal joints, expansion joint filler, elastomeric joint seals, silicone sealant, epoxy mortar for joint repair work, polyethylene tape, rope or rod joint back-up material, lubricant-adhesive for elastomeric seals, and dowels or load transfer devices as are required in the Plans; placing, finishing and curing; and all labor, equipment, tools, field laboratory, supplies and incidentals necessary to complete the work.

**501.23.1.1-**The core measurements which represent the thickness of the sampling units shall be analyzed to determine the average value of the pavement thickness. This value will be used to determine the degree of compliance with the provisions set forth in 501.19 and to develop certain factors to be used in the derivation of equitable deductions as set forth in 501.23.1.2 and 501.23.1.3, in the event the provisions of this Specification are not met.

No payment will be made for pavement areas deficient in thickness by more than 7.8%T, the area being defined in the manner set forth in 501.19.2. Pavement which is deficient in thickness by more than 0.7 inches (18 mm) and is considered by the Engineer to be inadequate to perform satisfactorily shall be removed and replaced at no added cost to the Division. The balance of the item, the portion of the item not treated in the manner set forth above, will be treated in the manner set forth in 501.23.1.2 or 501.23.1.3.

**501.23.1.2-**When the average value of the pavement thickness is equal to or greater than the specified thickness, the quantity of pavement represented by this average thickness will be paid at the contract unit price.

**501.23.1.3-**When the average value of the pavement thickness is less than the specified thickness, the fraction of pavement having a thickness greater than the specified thickness minus 7.8%T will be paid for at a unit price as set forth in the following schedule, and no payment will be made for the remainder of the pavement being considered.

<b>SCHEDULE OF UNIT PRICES</b>	
<b>AVERAGE VALUE OF PAVEMENT THICKNESS</b>	<b>UNIT PRICE AS PERCENT OF CONTRACT UNIT PRICE</b>
0.01 to 0.10 Less Than Specified Thickness	98.0
0.11 to 0.20 Less Than Specified Thickness	96.0
0.21 to 0.30 Less Than Specified Thickness	94.0
0.31 to 0.40 Less Than Specified Thickness	92.2
0.41 to 0.50 Less Than Specified Thickness	90.3
0.51 to 0.60 Less Than Specified Thickness	88.4
0.61 to 0.70 Less Than Specified Thickness	86.5
More Than 0.70 Less Than Specified Thickness	0

**501.24-PAY ITEMS:**

<b>ITEM</b>	<b>DESCRIPTION</b>	<b>UNIT</b>
501001-*	"Thickness" REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT	SQUARE YARD (METER)
501002-*	"Thickness" REINFORCED HIGH-EARLY-STRENGTH PORTLAND CEMENT CONCRETE PAVEMENT	SQUARE YARD (METER)
501003-*	"Thickness" REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT WIDENING	SQUARE YARD (METER)
501004-*	"Thickness" REINFORCED HIGH-EARLY STRENGTH PORTLAND CEMENT CONCRETE PAVEMENT WIDENING	SQUARE YARD (METER)
501005-*	"Thickness" NON-REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT	SQUARE YARD (METER)
501006-*	"Thickness" NON-REINFORCED HIGH-EARLY-STRENGTH PORTLAND CEMENT CONCRETE PAVEMENT	SQUARE YARD (METER)
501007-*	"Thickness" NON-REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT WIDENING	SQUARE YARD (METER)
501008-*	"Thickness" NON-REINFORCED HIGH-EARLY-STRENGTH PORTLAND CEMENT CONCRETE PAVEMENT WIDENING	SQUARE YARD (METER)
501010-*	BRIDGE APPROACH EXPANSION JOINT	EACH

\* Sequence Number